WHAT IS CLAIMED IS:

1. A process for making an epoxy resin comprising:

(a) converting a phenol or mixture of phenols to an aryl allyl ether of a phenol or mixture of phenols;

(b) converting the aryl allyl ether of a phenol or a mixture of phenols to an α-dihydroxy derivative of a phenol or mixture of phenols (i) in the presence of an oxidant or (ii) in the presence of an oxidant and a catalyst; and

(c) converting the α-dihydroxy derivative of a phenol or mixture of phenols to an aryl glycidyl ether epoxy resin of a phenol or mixture of phenols.

2. The process of Claim 1 wherein the phenol or mixture of phenols is represented by the structure of the following Formula VI:

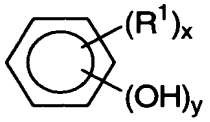
Formula VI

$$(R^1)_xAr(OH)_y$$

wherein Ar is an aromatic-containing moiety; R^1 is a group substituted for a hydrogen atom on the Ar moiety; OH is hydroxyl moiety; x is from 0 to 750; and y is from 1 to 150.

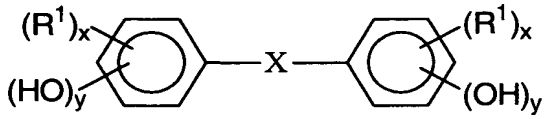
3. The process of Claim 2 wherein the phenol or mixture of phenols are one or more phenols represented by any one or more of the following Formulas VII-X:

Formula VII



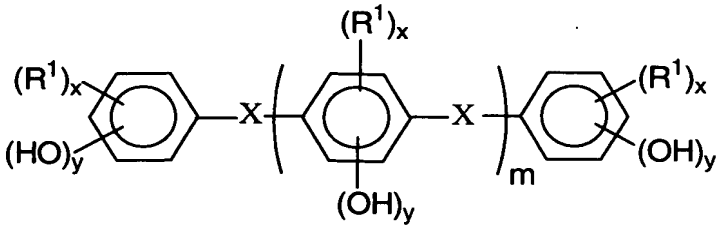
wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; OH is hydroxyl moiety; x is from 0 to 5; and y is from 1 to 4;

Formula VIII



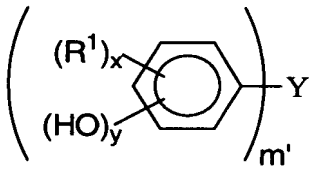
wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; OH is hydroxyl moiety; X is nil, a heteroatom with or without substituents thereon to complete its necessary bonding valence, -C(O)-; -S(O_2)-; -C(O)NH-; -P(O)Ar-; an organic aliphatic moiety, with or without heteroatoms, and —CR^3=CH—, where R^3 is hydrogen or an alkyl group, a cycloaliphatic group or aromatic group; a cycloaliphatic group, with or without heteroatoms; or an aromatic group, with or without heteroatoms; or any combination thereof; partially or fully fluorinated; each x is from 0 to 4, and each x can be the same or different; and each y is from 1 to 4, and each y can be the same or different;

Formula IX



wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; OH is hydroxyl moiety; X is nil, a heteroatom with or without substituents thereon to complete its necessary bonding valence, -C(O)-; -S(O_2)-; -C(O)NH-; -P(O)Ar-; an organic aliphatic moiety, with or without heteroatoms, and —CR^3=CH—, where R^3 is hydrogen or an alkyl group, a cycloaliphatic group or aromatic group; a cycloaliphatic group, with or without heteroatoms; or an aromatic group, with or without heteroatoms; or any combination thereof; partially or fully fluorinated; x is from 0 to 4, and each x can be the same or different; each y is from 1 to 4, and each y can be the same or different; and m is from 0.001 to 10;

Formula X



wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; OH is hydroxyl moiety; Y is an organic aliphatic moiety, with or without heteroatoms such as O, N, S, Si, B or P, or any combination of two or more of the above heteroatoms, wherein the aliphatic moiety has from 1 to 20 carbon atoms; a cycloaliphatic moiety, with or

without heteroatoms, having from 3 to 20 carbon atoms; an aromatic moiety, with or without heteroatoms; or any combination thereof, with no more than about 20 carbon atoms; partially or fully fluorinated; an organosiloxane unit with the aryl groups attached to the Si atoms directly or through an organic aliphatic, cycloaliphatic, aromatic group, or any combination thereof, with no more than about 20 carbon atoms; each x is from 0 to 4, and each x can be the same or different; each y is from 1 to 4, and each y can be the same or different; and m' is generally 3 or 4.

4. The process of Claim 3 wherein at least one of the hydroxyl groups is attached to the aromatic group via a monoalkylene oxide or a polyalkylene oxide moiety.

5. The process of Claim 3 wherein the phenol or mixture of phenols is selected from the group consisting of 2-methylphenol; 4-methylphenol; 4-methoxyphenol; 2,6-dimethylphenol; 2,6-diisopropylphenol; 2,6-dibromophenol; 1,2-, 1,3- and 1,4-dihydroxybenzene; 1,4-, 1,5- and 2,6-dihydroxynaphthalene; 4,4'-(3,3',5,5'-tetramethyl)bisphenol A; 4,4'-(3,3',5,5'-tetramethyl-2,2',6,6'-tetrabromo)bisphenol A; 4,4'-(3,3',5,5'-tetramethyl)bisphenol F; 4,4'-(3,3'5,5'-tetramethyl)biphenol; 4,4'-biphenol; 4,4'-(3,3'5,5'-tetramethyl-2,2',6,6'-tetrabromo)biphenol; 4,4'-bisphenol F; 4,4'-bisphenol sulfone; 2,2'-bis(3,5-dibromo-4-hydroxyphenyl)isopropylidene; 4,4'-bisphenol A; 4,4'-bisphenol K; 9,9-bis(4-hydroxyphenyl)fluorene; 4,4'-dihydroxy-α-methylstilbene; 1,3-bis(4-hydroxyphenyl)adamantane; phenol-formaldehyde novolac (functionality >2); o-cresol-formaldehyde novolac

(functionality >2); phenol-dicyclopentadienyl novolac (functionality >2); naphthol-formaldehyde novolac (functionality >2); trisphenylol methane; tris(3,5-dimethyl-4-hydroxyphenyl)methane; 1,1,2,2-tetraphenylol ethane; or mixtures thereof.

6. A process for making an α-halohydrin intermediate of a phenol or mixture of phenols comprising the steps of:

(a) converting an aryl allyl ether of a phenol or mixture of phenols to an α-dihydroxy derivative of a phenol or mixture of phenols (i) in the presence of an oxidant or (ii) in the presence of an oxidant and a catalyst; and

(b) converting the α-dihydroxy derivative to an α-halohydrin intermediate of a phenol or mixture of phenols.

7. The process of Claim 6 wherein the α-halohydrin intermediate of a phenol or mixture of phenols is represented by the structure of the following Formula XXI:

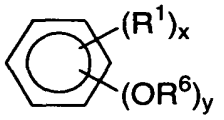
Formula XXI

$$(R^1)_x Ar(OR^6)_y$$

wherein Ar is an aromatic-containing moiety; R^1 is a group substituted for a hydrogen atom on the Ar moiety; R^6 is α-chlorohydrin propyl-containing moiety; x is from 0 to 750; and y is from 1 to 150.

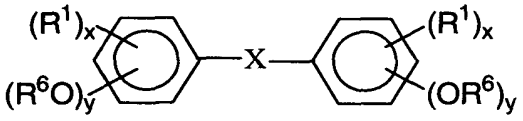
8. The process of Claim 7 wherein the α-halohydrin intermediate is one or more α-halohydrin intermdiates represented by any one or more of the following Formulas XXII-XXV.

Formula XXII



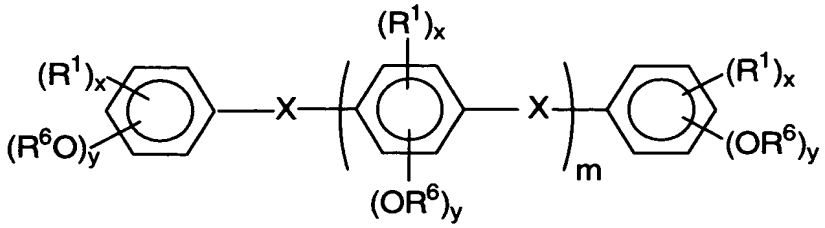
wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; R^6 is an α-chlorohydrin propyl-containing moiety; x is from 0 to 5; and y is from 1 to 4;

Formula XXIII



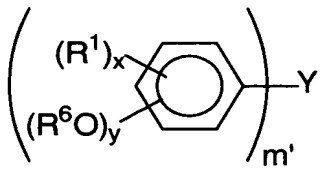
wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; R^6 is an α-chlorohydrin propyl-containing moiety; X is nil, a heteroatom with or without substituents thereon to complete its necessary bonding valence, -C(O)-; -S(O_2)-; -C(O)NH-; -P(O)Ar-; an organic aliphatic moiety, with or without heteroatoms, and —CR^3=CH—, where R^3 is hydrogen or an alkyl group, a cycloaliphatic group or aromatic group; a cycloaliphatic group, with or without heteroatoms; or an aromatic group, with or without heteroatoms; or any combination thereof; partially or fully fluorinated; each x is from 0 to 4, and each x can be the same or different; and each y is from 1 to 4, and each y can be the same or different;

Formula XXIV



wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; R^6 is an α-chlorohydrin propyl-containing moiety; X is nil, a heteroatom with or without substituents thereon to complete its necessary bonding valence, -C(O)-; -S(O_2)-; -C(O)NH-; -P(O)Ar-; an organic aliphatic moiety, with or without heteroatoms, and —CR^3=CH—, where R^3 is hydrogen or an alkyl group, a cycloaliphatic group or aromatic group; a cycloaliphatic group, with or without heteroatoms; or an aromatic group, with or without heteroatoms; or any combination thereof; partially or fully fluorinated; x is from 0 to 4, and each x can be the same or different; each y is from 1 to 4, and each y can be the same or different; and m is from 0.001 to 10;

Formula XXV

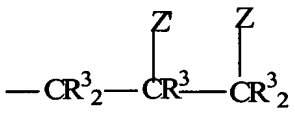


wherein R^1 is a group substituted for a hydrogen atom on the phenyl moiety; R^6 is an α-chlorohydrin propyl-containing moiety; Y is an organic aliphatic moiety, with or without heteroatoms such as O, N, S, Si, B or P, or any

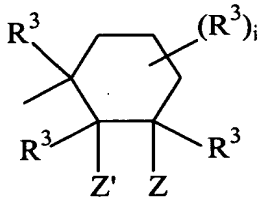
combination of two or more of the above heteroatoms, wherein the aliphatic moiety has from 1 to 20 carbon atoms; a cycloaliphatic moiety, with or without heteroatoms, having from 3 to 20 carbon atoms; an aromatic moiety, with or without heteroatoms; or any combination thereof, with no more than about 20 carbon atoms; partially or fully fluorinated; an organosiloxane unit with the aryl groups attached to the Si atoms directly or through an organic aliphatic, cycloaliphatic, aromatic group, or any combination thereof, with no more than about 20 carbon atoms; each x is from 0 to 4, and each x can be the same or different; each y is from 1 to 4, and each y can be the same or different; and m' is generally 3 or 4.

9. The process of Claim 8 wherein at least one R^6 is a monoalkylene oxide or a polyalkylene oxide terminated with a propenyl-containing moiety.

10. The process of Claim 8 wherein R^6 is a α halohydrin propyl-containing moiety preferably selected from the group consisting of:



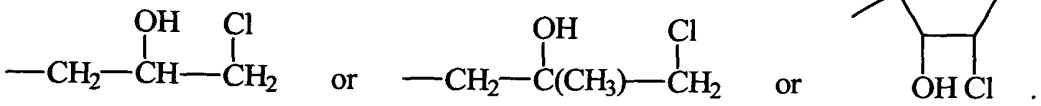
and



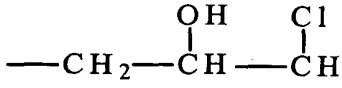
wherein Z is a halogen atom; Z' is a hydroxyl group; R^3 is the same or different in each occurrence and is hydrogen or an alkyl group, a cycloaliphatic group or aromatic group; and i is from 0 to 6.

11. The process of Claim 10 wherein the positions of the Z group and the Z' group may be interchanged.

12. The process of Claim 10 wherein R^6 is selected from the group consisting of:



13. The process of Claim 12 wherein R^6 is



14. The process of Claim 8 wherein α-halohydrin intermediate is a chlorohydrin intermediate selected from the group consisting of (3-chloro-2-hydroxy-1-propyl) ether of 2-methylphenol; (3-chloro-2-hydroxy-1-propyl) ether of 4-methylphenol; (3-chloro-2-hydroxy-1-propyl) ether of 4-methoxyphenol; (3-chloro-2-hydroxy-1-propyl) ether of 2,6-dimethylphenol; (3-chloro-2-hydroxy-1-propyl) ether of 2,6-diisopropylphenol; (3-chloro-2-hydroxy-1-propyl) ether of 2,6-dibromophenol; bis(3-chloro-2-hydroxy-1-propyl) ether of 1,2-, 1,3- and 1,4-dihydroxybenzene; bis(3-chloro-2-hydroxy-1-propyl) ether of 1,4-, 1,5- and 2,6-dihydroxynaphthalene; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-(3,3',5,5'-tetramethyl)bisphenol A; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-(3,3',5,5'-tetramethyl-2,2',6,6'-

tetrabromo)bisphenol A; bis(3-chloro-2-hydroxy-1-propyl)ether of 4,4'-(3,3',5,5'-tetramethyl)bisphenol F; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-(3,3'5,5'-tetramethyl)biphenol; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-biphenol; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-(3,3'5,5'-tetramethyl-2,2',6,6'-tetrabromo)biphenol; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-bisphenol F; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-bisphenol sulfone; bis(3-chloro-2-hydroxy-1-propyl) ether of 2,2'-bis(3,5-dibromo-4-hydroxyphenyl)isopropylidene; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-bisphenol A; bis(3-chloro-2-hydroxy-1-propyl)ether of 4,4'-bisphenol K; bis(3-chloro-2-hydroxy-1-propyl) ether of 9,9-bis(4-hydroxyphenyl)fluorene; bis(3-chloro-2-hydroxy-1-propyl) ether of 4,4'-dihydroxy-α-methylstilbene; bis(3-chloro-2-hydroxy-1-propyl) ether of 1,3-bis(4-hydroxyphenyl)adamantane; (3-chloro-2-hydroxy-1-propyl) ether of phenol-formaldehyde novolac (functionality >2); (3-chloro-2-hydroxy-1-propyl) ether of o-cresol-formaldehyde novolac (functionality >2); (3-chloro-2-hydroxy-1-propyl) ether of phenol-dicyclopentadienyl novolac (functionality >2); (3-chloro-2-hydroxy-1-propyl)ether of naphthol-formaldehyde novolac (functionality >2); tri(3-chloro-2-hydroxy-1-propyl) ether of trisphenylol methane; tri(3-chloro-2-hydroxy-1-propyl) ether of tris(3,5-dimethyl-4-hydroxyphenyl)methane; tetra-(3-chloro-2-hydroxy-1-propyl) ether of 1,1,2,2-tetraphenylol ethane; or mixtures thereof.

15. The process of Claim 14 wherein at least one of the 3-chloro-2-hydroxy-1-propyl moieties, the

chlorine atom and the hydroxy group of the α-chlorohydrin intermediate are interchanged to form a 2-chloro-3-hydroxy-1-propyl moiety.

16. The process of Claim 6 wherein step (b) comprises:

(i) reacting the α-dihydroxy derivative with a hydrogen halide in the presence of a carboxylic acid to form a phenolic-based α-halohydrin intermediate; or

(ii) reacting the α-dihydroxy derivative with a hydrogen halide in the presence of a carboxylic acid ester to form a phenolic-based α-halohydrin intermediate.

17. The process of Claim 16 in which the amount of hydrogen halide used is from about 0.5 to about 20 equivalents of hydrogen halide relative to the equivalents of α-dihydroxy moieties being reacted.

18. The process of Claim 16 in which the hydrogen halide is hydrogen chloride.

19. The process of Claim 16 wherein the carboxylic acid used in (i) is from about 0.05 mole % to about 50 mole % of carboxylic acid relative to the moles of α-dihydroxy derivative being reacted.

20. The process of Claim 16 wherein the carboxylic acid used in (i) is monocarboxylic acid or dicarboxylic acid having from 1 to 20 carbon atoms; or a multifunctional carboxylic acid wherein the carboxylic acid groups are attached to an inorganic, an organic, or a hybrid inorganic-organic support.

21. The process of Claim 20 wherein the carboxylic acid is selected from the group consisting of acetic acid, propionic acid, propenoic acid, 2-methylpropenoic acid, butanoic acid, 1,4-butanedioic acid, hexanoic acid, 1,6-hexanedioic acid, cyclohexanoic acid, 1,2-cyclohexandioic acid, benzoic acid, or mixtures thereof.

22. The process of Claim 21 wherein the carboxylic acid is acetic acid.

23. The process of Claim 16 wherein a carboxylic acid ester is used in (ii) to convert the α-dihydroxy derivative to the α-halohydrin intermediate.

24. The process of Claim 23 wherein the carboxylic acid ester used is from about 0.05 mole % to about 50 mole % of carboxylic acid ester relative to the moles of α-dihydroxy derivative being reacted.

25. The process of Claim 16 wherein the carboxylic acid ester is used as a solvent in (ii) to convert the α-dihydroxy derivative to the α-halohydrin intermediate.

26. The process of Claim 25 wherein the amount of carboxylic acid ester used as solvent is from about 0.25 to about 100 parts (on a weight basis) of carboxylic acid ester to 1 part α-dihydroxy derivative.

27. The process of Claim 16 wherein the carboxylic acid ester is the ester of a monocarboxylic acid or dicarboxylic acid having 1 to 20 carbon atoms.

28. The process of Claim 27 wherein the monocarboxylic acid or dicarboxylic acid may contain one or more heteroatoms selected from the group consisting of O, N, S, Si, B, P, Cl or F.

29. The process of Claim 27 wherein the monocarboxylic acid or dicarboxylic acid of the carboxylic acid ester is selected from the group consisting of acetic acid, propionic acid, propenoic acid, 2-methylpropenoic acid, butanoic acid, 1,4-butanedioic acid, hexanoic acid, 1,6-hexanedioic acid, cyclohexanoic acid, 1,2-cyclohexandioic acid, benzoic acid, or mixtures thereof.

30. The process of Claim 16 wherein the carboxylic acid ester is the ester of an aliphatic mono alcohol, diol, or triol having 1 to 12 carbon atoms.

31. The process of Claim 30 wherein the hydroxyl group(s) of the aliphatic mono alcohol, diol, or triol is a primary or secondary hydroxyl group.

32. The process of Claim 30 wherein the aliphatic mono alcohol, diol, or triol may contain one or more heteroatoms selected from the group consisting of O, N, S, Si, B, P, Cl or F.

33. The process of Claim 31 wherein the aliphatic mono alcohol, diol, or triol is selected from the group consisting of methanol, ethanol, propanol, isopropanol, 1-butanol, 2-butanol, isobutanol, cyclohexanol, benzyl alcohol, 1-methoxy-2-propanol, 1-ethoxy-2-propanol, ethylene glycol, diethylene glycol, propylene glycol, diproplene glycol, glycerine, trimethylolpropane or mixtures thereof.

34. The process of Claim 16 wherein the carboxylic acid ester is selected from the group consisting of ethyl acetate, propyl acetate, isopropyl acetate, 1-methoxy-2-propanol acetate, butyl acetate, ethylene glycol diacetate, propylene glycol diacetate, trimethylolpropane triacetate or mixtures thereof.

35. The process of Claim 16 using at least one or more optional solvents.

36. The process of Claim 35 wherein the at least one or more optionally used solvents are selected from the group consisting of aliphatic and cyclic hydrocarbons; aromatic hydrocarbons; chlorinated solvents; aprotic solvents; protic solvents; partially or fully fluorinated derivatives thereof; or any combination thereof.

37. The process of Claim 36 wherein the protic alcohol solvents optionally used are secondary or tertiary alcoholic solvents.

38. The process of Claim 36 wherein the at least one or more optionally used solvents are selected from the group consisting of pentane, hexane, octane, *iso*-octane, cyclohexane, cyclooctane, benzene, toluene, methylene dichloride, tetrachloroethane, chlorobenzene, acetone, methyl *iso*-butyl ketone, acetonitrile, dimethoxyethane, 2,2'-dimethoxy diethyl ether, dioxane, dimethyl sulfoxide, 1-methoxy-2-acetoxypropane, isopropyl alcohol, 2-butanol, *tert*-butanol, *tert*-amyl alcohol, cyclohexanol, and 1-methoxy-2-hydroxypropane; partially or fully fluorinated derivatives thereof; or any combination thereof.

39. The process of Claim 35 wherein the at least one or more optionally used solvents may be used with or without the presence of water.

40. The process of Claim 35 wherein the amount of at least one or more optionally used solvents is from zero to about 50 parts (on a weight basis) of a single solvent or a mixture of two or more solvents to 1 part α-dihydroxy derivative.

41. The process of Claim 25 including an amount of carboxylic acid ester used as solvent, and an amount of at least one or more optionally used second solvents such that the carboxylic acid ester is present in an amount that is greater than 25 mole % relative to the amount of α-dihydroxy derivative.

42. The process of Claim 16 wherein the temperature is from about 0 °C to about 150 °C.

43. The process of Claim 16 wherein the pressure is atmospheric, subatmospheric or superatmospheric.

44. A process for making an epoxy resin comprising the steps of:

(a) preparing an aryl allyl ether of a phenol or mixture of phenols by reacting (i) a phenol or a mixture of phenols with (ii) an allylation agent;

(b) converting an aryl allyl ether of a phenol or mixture of phenols to an α-dihydroxy derivative of a phenol or mixture of phenols (i) in the presence of an

oxidant or (ii) in the presence of an oxidant and a catalyst;

(c) reacting the α-dihydroxy derivative prepared in step (b) with (i) a hydrogen halide and (ii) a carboxylic acid or carboxylic acid ester to form a phenolic-based α-halohydrin intermediate; and

(d) converting the phenolic-based α-halohydrin intermediate prepared in step (c) to an epoxy resin.

45. A product made by the process of Claim 1, Claim 16 or Claim 44.

46. The process for making an epoxy resin of Claim 1 wherein step (b) is carried out by (i) reacting the α-dihydroxy derivative with a hydrogen halide and a carboxylic acid ester to form a phenolic-based α-halohydrin intermediate; and (ii) converting the phenolic-based α-halohydrin intermediate prepared in step (i) to an aryl glycidyl ether epoxy resin compound.